ANNEX 2
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
AND
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY (VT)
UNDER
SPACE ACT UMBRELLA AGREEMENT SAA1-36204
FOR
ADVANCED SENSING FOR URBAN AIR MOBILITY AND INTELLIGENT
TRANSPORATION SYSTEMS

ARTICLE 1. PURPOSE

This Annex shall be for the purpose of a collaboration between NASA Langley Research Center (LaRC) and Virginia Polytechnic Institute and State University (Virginia Tech). to perform collaborative advanced sensing research and development in unmanned aerial systems mobility.

The first activity under this partnership supports NASA interests in Advanced Air Mobility, specifically under programs for weather tolerant operations being funded by Convergent Aeronautics Solutions and Transformational Tools and Technologies. Wind measurement has been identified as a critical need by the projects of Micro-weather Moderation and Ubiquitous Weather Sensing. Virginia Tech has developed, partially under separate NASA funding from the University Leadership Initiative, a technique for using vehicle navigation data to measure wind, thus possibly eliminating the need for an expensive and cumbersome anemometer as a sensor payload. While promising, the Virginia Tech results need validation, which can be accomplished by NASA providing its expertise and equipment with Doppler wind lidar. VT has access to a variety of certified/certifiable aerial tests localities.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113(e)).

ARTICLE 2. RESPONSIBILITIES

A. NASA LaRC will use reasonable efforts to:

1. NASA to provide information on current NASA advanced sensing capabilities and specific areas of interest for autonomous operations of air vehicles as they relate to the overall NASA vision for UAM and AAM.
2. Provide access to NASA LaRC facilities such as NASA's Experimental Test Range (ETR), or Wireless Intelligent Sensing Electromagnetic Environmental Effects Research (WISE3R) labs, Lidar instrumentation lab, Small SWAP Lab, and CERTAIN wind mapping.

3. Provide access/availability and pre-certifications/authorizations to conduct experimental assessments, and proving ground-air baseline activities at the NASA LaRC, Research Directorate, Electromagnetic and Sensors Branch facilities and others as needed.
4. Define specific scenarios and use cases that use advanced sensing and autonomy to integrate and operate intelligent surface ground and air transportation systems.
5. Provide access to and information about NASA LaRC sensors, such as radar, lidar, or imagers, for collaborative research at VT sites. (Sensor installation, operation, and data reduction will involve NASA workforce in an as-needed basis).
6. Assess the feasibility of conducting collaborative research based on the selected scenarios and use cases. The assessment should include multiple options for scope and levels of effort for each of the Parties.
7. Work with the Partner to generate a final report detailing work carried out in under this Annex.

B. Partner will use reasonable efforts to:

1. VT to provide information on current VT intelligent transportation systems research with a specific emphasis on automated and UAS operations.
2. Provide access to and information on VT facilities such as the Kentland Farm, Drone Park, and Smart Roads Surface Street Section, bridges, etc. for testing sensors. Project specifications are to be determined, but generally involve VT providing a location, power, and data connection for a sensor.
3. Provide access/availability and pre-certifications/authorizations to conduct experimental assessments, and proving ground-air baseline activities at VT test sites, including stakeholders' identified test sites. This may include wind vector assessment near critical flight locations (e.g., vertiports)
4. Define specific scenarios and use cases that use advanced sensing and autonomy to integrate and operate intelligent surface ground and air transportation systems. Very near ground level wind characterization (for both aerial and ground vehicles). May include RT RF environment characterization and airborne sensor impact assessment (e.g., RFI impacts on radio altimeters and required backup systems).
5. Assess the feasibility of conducting collaborative research based on the selected scenarios and use cases. May include weather impacts on automated systems and sensors. (e.g. Ground level wind predictions based on winds aloft, solar heating, etc.) The assessment should include multiple options for scope and levels of effort for each of the Parties.
6. Work with NASA to generate a final report detailing work carried out under this Annex.

ARTICLE 3. <u>SCHEDULE AND MILESTONES</u>

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

1. NASA to provide information on current NASA advanced sensing capabilities and specific areas of interest for autonomous operations of air vehicles as they relate to the overall NASA vision for UAM and AAM.	Within two (2) months of execution of this Annex.
2. Provide access to NASA LaRC facilities	Within two (2) months of execution of this Annex
3. Provide access/availability and pre-certifications/authorizations to conduct experimental assessments, and proving ground-air baseline activities at as needed.	Within four (4) months of execution of this Annex
4. Provide access to and information about, NASA LaRC sensors, such as radar, lidar, or imagers, for collaborative research at the VT research sites. (Sensor installation, operation, and data reduction will involve NASA workforce in an as-needed basis).	Within four (4) months of execution of this Annex
5. Deploy NASA-owned Doppler wind lidar at the VT Kentland Farm site for a comparison of lidar measurements with VT-developed techniques for wind measurements from vehicle navigation data. NASA personnel will install, operate, and remove the lidar equipment	Within nine (9) months of execution of this Annex
6. VT and NASA will generate a final report detailing work carried out in Annex 2.	Within twelve (12) months of execution of this Annex

ARTICLE 4. <u>FINANCIAL OBLIGATIONS</u>

There will be no transfer of funds between the Parties under this Agreement and each Party will fund its own participation. All activities under or pursuant to this Agreement are subject to the availability of funds, and no provision of this Agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, (31 U.S.C. § 1341).

ARTICLE 5. <u>INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS</u>

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of one year.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.
1. Background Data: *The Disclosing Party's Background Data, if any, will be identified in a separate technical document.*
2. Third Party Proprietary Data: *The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.*
3. Controlled Government Data: *The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.*
4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: *None*

ARTICLE 6. <u>TERM OF ANNEX</u>

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or two years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

ARTICLE 7. <u>RIGHT TO TERMINATE</u>

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 8. <u>POINTS OF CONTACT</u>

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

Management Points of Contact	
<u>NASA Langley Research Center</u> Jennifer Hubble Viudez Center Agreements Manager Mail Stop: 254 Hampton, VA 23681 Phone: 202.256.6861 jennifer.m.hubble@nasa.gov	<u>VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY</u> Christy Cochrane Federal Contracts Program Coordinator 300 Turner Street NW Suite 4200 (MC 0170) Blacksburg, VA 24060-1118 Phone: 540-231-6638 christyc@vt.edu

NASA Langley Research Center Daniel M. Williams AST, Engineering Project Management Mail Stop: 251 Langley Research Center Hampton, VA 23681 Phone: 757-864-3096 daniel.m.williams@nasa.gov	
Technical Points of Contact	
NASA Langley Research Center Grady J. Koch AST, Electro-Optical Sensor Sys Mail Stop: 062 Langley Research Center Hampton, VA 23681 Phone: 757-864-3850 grady.j.koch@nasa.gov	VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Craig Woolsey Professor, Kevin T. Crofton Department of Aerospace 300 Turner Street NW Suite 4200 (MC 0170) Blacksburg, VA 24060-1118 Phone: 540-449-9182 cwoolsey@vt.edu

ARTICLE 9. MODIFICATIONS

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LANGLEY RESEARCH CENTER	VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
BY:_____ Mary DiJoseph Director, Aeronautics Research Directorate	BY:_____ Trudy M. Riley, Associate Vice President for Research and Innovation, Sponsored Programs
DATE:_____	DATE:_____